

FURTHER OBSERVATIONS ON DEPRESSION OF
THE NECK OF THE FEMUR IN EARLY LIFE;
INCLUDING FRACTURE OF THE NECK OF
THE FEMUR, SEPARATION OF THE EPIPHYSIS
AND SIMPLE COXA VARA.¹

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IN 1890 I reported a case of fracture of the neck of the femur in a child.² Since then seventeen similar cases have come under my observation. In 1897 it was possible to confirm the diagnosis, which until that time had depended upon the physical signs, by Röntgen pictures, and during the present year the exact nature of the injury has been demonstrated by specimens.

Of the eighteen cases, eight were in males and ten in females.

Ages: between two and three years, 2; between three and six years, 7; between six and nine years, 7; sixteen years of age, 2; total, 18.

The nature of the accidents:

One fell from a window of the second floor of a house, one fell from a window of the third floor, two fell from a window of a fourth floor, one fell from a window of the sixth floor; one was run over; five fell from heights averaging fourteen feet; four fell down flights of stairs; one was injured in a game of football; in one case the history was indefinite.

¹ Read before the New York Surgical Society, November 8, 1899.

² Patient presented at a meeting of the Orthopaedic Section of the New York Academy of Medicine, December 9, 1890. See report, *New York Medical Journal*, February 7, 1891.

The physical characteristics of fracture of the neck of the femur in childhood are as follows :

A child, previously in perfect health, after an accident of the nature indicated, presents an actual shortening of the limb of one-half to three-quarters of an inch. This shortening is explained by a corresponding elevation of the trochanter, which is usually abnormally prominent and is slightly displaced towards the anterior superior spine ; there is also slight outward rotation of the leg. For several weeks or months after the injury there may be discomfort on manipulation, and muscular spasm may restrict motion ; but when repair is completed, the range of motion is either unrestricted or but slightly limited in extreme abduction, flexion, and inward rotation ; and a slight limp is the only symptom that is apparent.

My persistence in calling attention to fracture of the neck of the femur in childhood may be explained by the fact that until very recent years this injury was supposed to be confined to adult age ; and even at the present time, in no text-book, is attention called to the peculiarities that distinguish it from the ordinary type.

Fracture of the neck of the femur in childhood does not usually entail the immediate helplessness and persistent disability that are associated with the injury. In many instances the patients are able to walk about within a few days after the accident. Thus it may be inferred that the separation of the fragments is usually incomplete, and that the fracture is rather a bending and breaking than a displacement or impaction.

Either because this injury is supposed to be confined to adult age, or because the immediate symptoms are slight, or because a physical examination is not made, a primary diagnosis is unusual ; but the persistent limp, accompanied, it may be, by discomfort or pain during the stage of repair, is very often mistaken for hip-disease ; a mistake to which I am indebted for the opportunity to examine the patients at the Orthopædic clinics with which I am connected.

Four patients were seen within the first month after the accident, seven were seen within two months, five within six

months, and two within one or more years after the injury had been received.

Besides the clinical peculiarities that have been mentioned, there is still another point of interest that entitles it to special notice.

This fracture in older subjects entails immediate and persistent disability from which gradual improvement may be predicted. In childhood the period of disability is short, and the immediate result is practically perfect functional recovery; but as the neck of the femur in its new position is subjected to greater strain, a gradual exaggeration of the depression, with its attendant symptoms of actual and apparent shortening, limp, and disability, is extremely probable.

Thus, the patient who has sustained a fracture of the neck of the femur is in the early stage of what is likely to be progressive coxa vara. The fact that simple depression of the neck of the femur in a healthy child predisposes very strongly to progressive deformity, as was proved by the examination of a number of patients several years after the injury, is of interest as throwing light on the etiology of simple coxa vara; and it is also of importance as an indication for treatment.

There is one other point of minor importance that may be mentioned in connection with this injury in childhood. Taking it for self-evident, that an elevation of the trochanter, and a corresponding shortening of the limb, without dislocation, can only be accounted for by a depression of the neck of the femur, the question remains as to the exact situation of the injury, whether it be in the neck or in the head of the bone at the epiphyseal line.

Elsewhere I have considered this question at some length. In brief, the points in favor of fracture of the neck in distinction to separation of the head are these:

Under the influence of sudden violence applied to the upper extremity of the femur, the injury is more likely to be of the smaller and weaker part, the neck, rather than at the larger and better protected epiphyseal junction.

This conclusion is borne out by the history and by the physical signs, for if the fracture were at the epiphyseal line,

thus involving the articular surface of the joint, and there were sufficient separation of the fragments to explain three-quarters of an inch of shortening, the function of the joint must be impaired by the irregularity, increased by callus formation during the stage of repair; whereas, in nearly all the cases that I have reported the function of the joint was practically perfect.

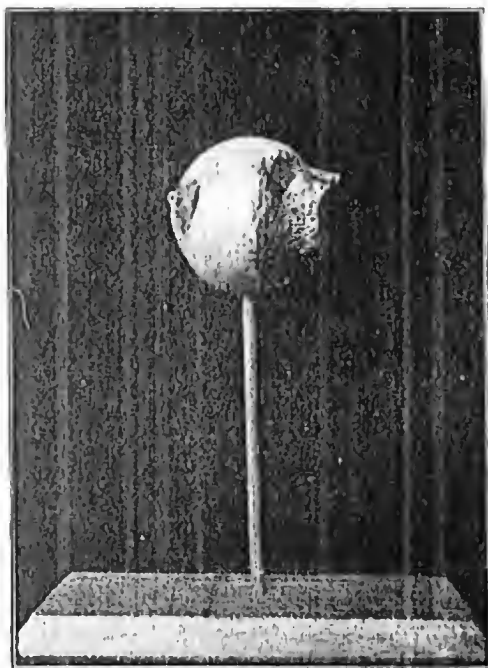


FIG. 1.—Fracture of the neck of the femur. Bolton's case. The fracture is of the middle of the neck, which in early childhood is less than an inch in length.

The Röntgen pictures show the depression to be of the neck as a whole rather than at the epiphyseal junction, except in one instance, to which attention will be called.

Anatomical proof, the only positive evidence, can hardly

be attained in the ordinary case; but this is now no longer lacking, as is demonstrated by accompanying photographs of a case seen with Dr. P. R. Bolton.¹ The patient, a boy of eight years of age, fell from the sixth story of a house and received



FIG. 2.—Section showing the epiphyseal cartilage.

a severe injury of the right hip. He was taken to Bellevue Hospital, where a diagnosis of fracture of the neck of the femur was made. Four weeks later, as there seemed to be no indication of repair, the distal fragment, consisting of the head and

¹ Two other anatomical specimens of fracture of the neck of the femur in young children, obtained at autopsy, were described at the last meeting of the American Orthopaedic Association,—one by Dr. T. H. Myers, of New York, the other by Dr. C. L. Starr, of Toronto.

nearly one-half of the neck of the bone, was removed by Dr. Bolton.

I mention the subject at this time because Sprengel, of Brunswick, has recently described two cases of epiphyscal separation in adolescents. (*Archiv für klinische Chirurgie*, Band xlvii, 1898, S. 805.)

CASE I.—A boy seventeen years of age was admitted to the hospital in April, 1897, walking with difficulty with the aid of a cane. The left leg was adducted and rotated outward. The trochanter was prominent and was above Nélaton's line. There was an actual shortening of two centimetres, and an apparent shortening of six centimetres. The range of flexion and abduction was much restricted. These symptoms were of three weeks' duration. The actual disability was of sudden onset, accompanied by pain in the hip, while the patient was walking. On close questioning he acknowledged that he had suffered discomfort in the hip that had obliged him to drag the leg for some time before. An excision was performed, and the specimen showed downward displacement of the epiphysis of the head, which was, however, firmly fixed to the neck. The patient left the hospital seven months later, walking with the aid of a cane.

CASE II.—A boy of eighteen years was admitted to the hospital in November, 1897. The physical signs were almost identical with those of the preceding case, except that the disability was of the right leg. The symptoms were of sudden onset, following a fall from the knee of another man to a stone floor. As in the first case, the patient had suffered previously from discomfort referred to the hip. The specimen obtained by excision resembled the first very closely. Seven months later the patient was discharged walking with two canes.

In his article, Sprengel refers at some length to the ten cases of fracture of the neck of the femur that I had reported, and concludes that these were in reality cases of separation of the epiphysis, on the following grounds:

(1) That he had demonstrated this accident in two cases, while I had presented no anatomical evidence.

(2) That it was an axiom that the epiphyscal line was a weak point in the bone, and therefore separation rather than fracture was to be inferred.

These arguments are of little weight, since the cases re-

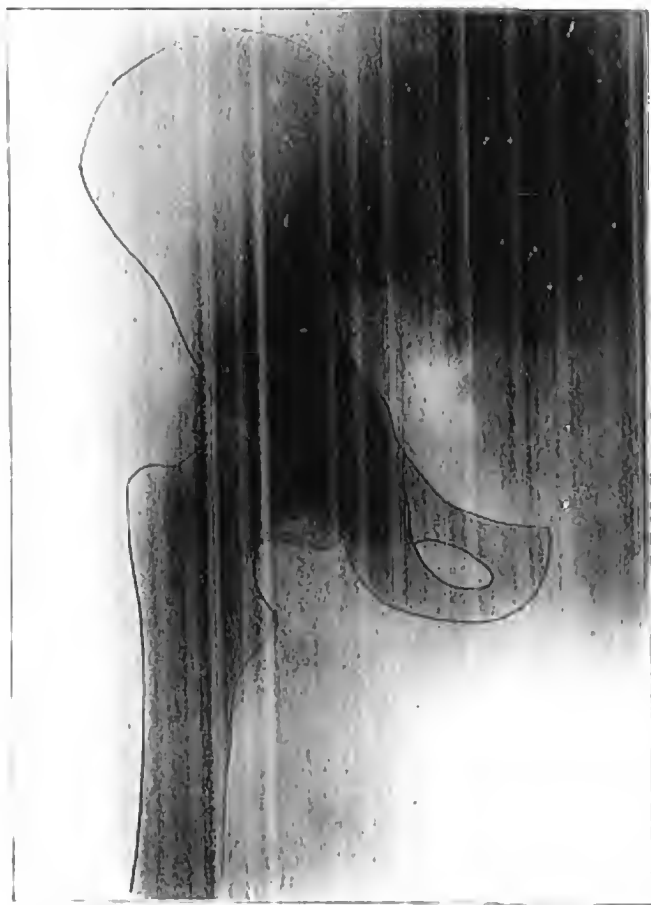


FIG. 3.—Separation of the epiphyses of the head of the femur.

ported by Sprengel were in adolescents, in both of whom there was evidence of previous weakness in the part, as shown by discomfort and disability preceding the acute symptoms; while all of the ten cases reported by me were in children less than eight years of age, who were in perfect health up to the time of the accident.

The anatomical evidence of fracture is now supplied, and, finally, it may be stated that there is neither clinical nor experimental nor anatomical evidence to support the assertion that the epiphyseal junction is a weak point in the bone of a healthy child, in the sense that separation at that point is more common than fracture. If this junction is ever a weak point in this sense, it is not in childhood, but rather in adolescence, when the external cartilage and resistant covering of periosteum have diminished to nearly the adult condition. It is at this age and in the class of cases that Sprengel has described, that epiphyseal separation may be caused by a slight degree of violence. The following case, which has recently come under my observation, is an example:

A boy sixteen years of age, who had been under observation for suspected coxa vara of the right side, came again to the Hospital for Ruptured and Crippled on October 10, 1899.

Three weeks before, while playing football, his left thigh was violently abducted while he was in the sitting posture. After walking a short distance, the pain, discomfort, and weakness increased so that he required assistance in reaching his home. Since then he had been walking about more or less with the aid of a crutch, which he still used. Examination showed symptoms very similar to those of the preceding cases. There was slight flexion and outward rotation of the leg, one inch of shortening, and a corresponding elevation of the trochanter, which was not, however, especially prominent. Motion caused some discomfort and was accompanied by a clicking sound. This at first was thought to be due to movement of the fragments on one another, but it was probably caused by the slipping of the tissues over the trochanter. A short spica plaster bandage and a traction hip-splint relieved his symptoms and enabled him to walk about with ease (Fig. 4). The accompanying Röntgen picture shows typical epiphyseal separation.

In certain cases of coxa vara of the adolescent type, the point of greatest deformity, as shown in Röntgen pictures, may be at the epiphyseal line, and the first symptoms may follow slight injury or over-strain ; but it has seemed to me that these might be classed more properly as varieties of coxa vara than

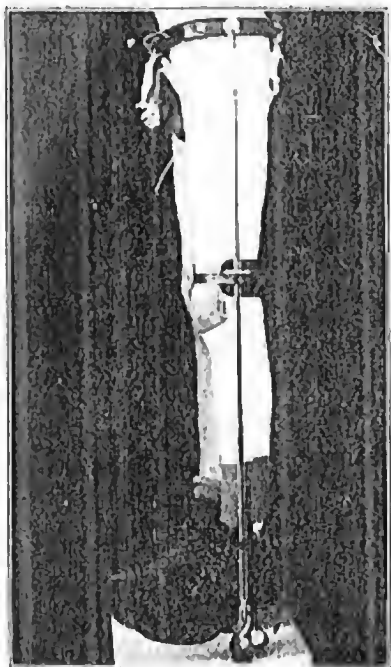


FIG. 4.—An effective treatment for fracture of the neck of the femur. A plaster spica bandage extending from the lower ribs to the knee, combined with a traction hip-splint.

of simple fracture or epiphyseal disjunction, because the primary symptoms were not disabling, and because the course of the affection did not differ from that of the ordinary type of this deformity. In such cases it may be inferred that the injury may have broken the cortical substance over the epiphyseal junc-

tion, and that the newly formed bone has gradually given way under use.

Coxa vara, of which fracture of the neck of the femur in childhood is, practically speaking, the traumatic form, is a deformity at the hip-joint, corresponding in its etiology and significance to genu valgum or varum. It differs from them in that, as the distortion is concealed from view, its diagnosis must depend, in the early stage at least, upon a proper interpretation of the symptoms. These symptoms, however, are caused directly by the deformity and by the weakness that accompany it. In most instances the depression of the neck of the femur is backward; thus there is an elevation and prominence of the trochanter, and a corresponding shortening of the limb which is rotated outward. Motion is somewhat limited in abduction, flexion, and inward rotation. If, as in rare instances, the neck is depressed in a forward direction, outward rotation and extension will be restricted in place of inward rotation and flexion. In all instances the limp is the most important symptom; with this there is often complaint of discomfort, particularly of stiffness, referred to the hip and thigh; and if the deformity is progressive, as in adolescence, these symptoms may be increased to actual acute pain, particularly after exertion or if aggravated by injury. The limp is, in quiescent cases, caused by actual shortening; but as the deformity progresses this is exaggerated by the upward tilting of the pelvis in compensation for the restricted range of abduction. It is of interest to note that tilting of the pelvis is often present before the range of abduction is greatly restricted by the actual deformity. This represents, doubtless, the instinctive adaptation to the new condition, the lessening of the strain upon the weakened part by adducting the limb. Bilateral coxa vara differs from the unilateral form only in its effects upon the gait and attitude.

Unilateral coxa vara, as well as fracture of the neck of the femur, is usually mistaken for disease of the hip-joint, although the distinction between the two is marked. In coxa vara the shortening of the limb, explained by the elevated and prominent trochanter, is present from the first, while in disease of the hip shortening is a late symptom.

In coxa vara the motion of the hip is restricted in certain directions and is unrestricted in others, while in hip disease motion is checked in all directions by muscular spasm, which in coxa vara is an unusual symptom.

I have elsewhere recently described the peculiarities of coxa vara, and it is hardly necessary in this connection to speak of the exceptional cases in which the diagnosis may be more difficult.

Since 1892, thirty cases of this affection have come under my observation. Of the thirty cases, twenty-two were in males, eight in females.

The deformity was unilateral in twenty-five (right, fifteen; left, ten), bilateral in five.

The neck of the femur was displaced downward and backward in twenty-seven, downward and forward in three.

The ages at which the symptoms first became noticeable appeared to be as follows:

Adolescents, 12-17	14
Later childhood, 5-11	10
Early childhood, less than 5	5
Unknown	1

The Etiology of Simple Coxa Vara.—In very many instances coxa vara may be explained by an acquired or an inherited predisposition to the deformity. The normal inclination of the neck of the femur protects it from strain; if for any cause this angle is diminished the strain upon the part is proportionately increased. This is proved by the fact that simple traumatic depression predisposes to further deformity long after the repair of the injury. Thus, one may assume that in many instances a slight depression is acquired in childhood as a result of rickets, of which there was a clear history in more than a third of the thirty cases, including all of the bilateral form. Such depression may remain latent, or, under favoring circumstances, it may become exaggerated to noticeable deformity. These favoring circumstances are more likely to occur during adolescence, when to the instability of rapid growth is added the

increase in the weight of the body, and in some instances the over-strain of laborious occupation.

In other instances there may be a congenital predisposition caused either by a lessened angle or by abnormal weakness of structure. In none of the cases in later childhood or adolescence has there been evidence of active or late rickets, and the presence of so-called local rickets, as accounting for the deformity, is at present unproved.

In a small percentage of the cases the early symptoms appear to have been induced or aggravated by over-strain or injury, but as a rule the symptoms appear insidiously and without assignable cause.

In childhood these symptoms are slight and are often remittent, and the progress of the deformity is slow, but in adolescence it is more rapid, the symptoms are more marked, and it may be, at times, disabling. When the resistance of the compressed bone checks the deformity the symptoms cease, and improvement in functional ability follows; but a well-marked limp always remains; the actual shortening is about an inch, but the upward tilting of the pelvis, due to the limitation of abduction, usually increases this considerably, and it may add greatly to the disability, especially if the affection is bilateral.

A more extended observation of depression of the neck of the femur has modified in some degree my opinion as to its treatment. Formerly, operative treatment seemed to be indicated simply for the correction of fixed adduction of the limb, and for this purpose linear osteotomy below the trochanter minor, which allows one to correct the outward rotation as well as the adduction, proved to be an effective treatment in two cases of the adolescent type. (The first operation was performed in 1894; the second in 1896.)

In the less advanced cases, apparatus to remove the strain, combined with exercises, was employed; but this treatment, although it was effective in relieving the symptoms, did not assure the patient from recurrence while the local predisposition remained. For this reason, a prophylactic operation for the purpose of replacing the neck of the femur at its former angle suggested itself. This was accomplished in six instances by

means of the removal of a sufficient wedge of bone from the base of the trochanter.

In four of the cases the depression was due to injury, in the two others it was simple coxa vara. All of the patients were children. A brief description of the cases may be of service in illustrating the clinical characteristics of the deformity.

CASE I.—*Traumatic Coxa Vara; Fracture of the Neck of the Femur.*—A girl three and a half years of age was first seen at the Vanderbilt clinic, September 21, 1895. Two weeks before, she had fallen down a flight of stairs, and since the accident she had limped, and had complained of discomfort about the right hip.

She presented the usual signs of traumatic depression of the neck of the femur, an elevated and prominent trochanter, outward rotation of the leg and half an inch of actual shortening.

One year later the shortening was three-quarters of an inch. Two years after the accident the shortening had increased to one inch, and the limp, increased by the progressive restriction of abduction of the limb, had become very noticeable.

The operation was performed at the Hospital for Ruptured and Crippled in August, 1897. A brace was worn for several months and then was discarded. At the present time, more than two years later, there is perfect functional ability, no limp or discomfort, and less than three-quarters of an inch of actual shortening.

CASE II.—*Simple Coxa Vara.*—A boy seven years of age was seen at the Hospital for Ruptured and Crippled in January, 1898. He was brought there by his parents because of a limp and discomfort about the right hip. The duration of the symptoms was two years. There was a clear history of infantile rhachitis, and slight bowing of the legs was evident.

On inspection, the physical signs were of coxa vara of the right femur, the shortening being but half an inch. The patient was kept under observation for six months, and, as the deformity was evidently progressive, the operation was performed at the hospital August 9, 1898. No apparatus was used in the after-treatment.

At the present time there is no discomfort, no limp or evidence of disability. The actual shortening is less than half an inch.

CASE III.—*Traumatic Coxa Vara.*—A girl nine years of age was brought to the Hospital for Ruptured and Crippled, July 16, 1898.

At the age of two years she had fallen (distance not noted). For two months after the accident she had refused to walk, since then she has limped somewhat, but within a few months the limp had increased and the child had complained of discomfort and pain. The examination showed typical coxa vara of a rather extreme degree. There



FIG. 5.—Case IV. Photograph of the patient, showing the effect of slight depression of the neck of the left femur upon the attitude.

was one inch of actual shortening, increased by an almost complete restriction of abduction.

The operation was performed in August, 1898, division of the adductors being required in order to allow the complete abduction of

the femur. As the family has left the city, the present condition is unknown. According to a friend, the patient was much improved by the operation.

CASE IV.—*Simple Coxa Vara in the Early Stage*.—A girl seven and a half years of age was seen at the hospital in June, 1899. She had for four months suffered somewhat from discomfort referred to the left hip, and there was a well-marked limp. The usual signs of coxa vara in the early stage were present. The shortening was half an inch. (Fig. 5.)

As there seemed to be a probability of progressive deformity, the preventive and corrective operation was performed on August 27, 1899. At the present time there is no limp, less than a half inch of shortening, and no discomfort.

A comparison of the Röntgen pictures will show the effect of the operation. (Figs. 6 and 7.)

CASE V.—*Traumatic Coxa Vara*.—The patient, a boy ten years of age, had been under observation for seven years. In 1892, when about three years of age, he had fallen from the fourth story, but apparently was not seriously injured. As a limp persisted after the accident, he was brought to the hospital one month later. He then presented the signs of typical fracture of the neck of the femur, with three-quarters of an inch of shortening. The application of a brace relieved the symptoms of discomfort and weakness, and on its removal the limp was very slight. An examination five years later showed that the shortening, due to further depression of the neck of the femur, had increased to one and a quarter inches. Two years later the actual shortening remained the same, but the practical shortening, caused by the restriction of abduction and to the compensatory tilting of the pelvis, was two inches, and the limp was, of course, very marked.

The operation was performed on September 10, 1899, the primary object being to overcome the restriction of abduction. The patient is now walking about, but the time is too short for an estimation of the functional result. (The improvement is very marked January 14, 1900.)

CASE VI.—*Traumatic Coxa Vara*.—A girl seven years of age was seen at the hospital in September, 1899. The previous year she had fallen down a flight of stairs. She was taken to a hospital, where she was treated, according to the mother's account, for a dislocation of the hip. After discharge from the hospital, she had continued to limp.



FIG. 6.—Case IV. Coxa vara of the left hip in the early stage.



FIG. 7.—Case IV. Illustrates the effect of the operation in replacing the neck of the femur in its normal position.

In this case there was evident depression of the neck of the femur, resulting in one-third of an inch shortening.

The prophylactic operation of replacing the neck of the bone was performed on November 9.

This operation is, of course, more likely to be successful in childhood than in adolescence. In childhood the neck of the femur is short, and the strain to which it is likely to be subjected subsequently is slight; but in adolescence the part is longer and, as would appear from clinical histories, much less resistant; thus, in certain cases of this type, if the affection is well advanced, operative treatment should be deferred until the progression of deformity has ceased.

In the technique of this procedure there are several points of importance. First, all restriction of abduction, of ligamentous or muscular origin, must be overcome by vigorous manipulation before the operation on the bone, otherwise it will be difficult to bring the two fragments into proper apposition. The base of the wedge should be about three-quarters of an inch in breadth, directly opposite the trochanter minor; the upper section should be practically at a right angle with the shaft, the lower being more oblique. The cortical substance on the inner aspect of the bone should not be divided, but, reinforced by the cartilaginous trochanter minor, should serve as a hinge on which the shaft of the femur is gently forced outward until the opening is closed by the apposition of the fragments after the upper segment has been fixed by contact with the margin of the acetabulum; thus the continuity of the bone is preserved. The leg is then held in the attitude of extreme abduction by means of a plaster spica bandage, which should include the foot also, until the union is firm.

In regard to fracture of the neck of the femur, it is of course desirable to establish a diagnosis immediately after the injury, and the fact that this is so often overlooked emphasizes the importance of a thorough physical examination in all cases of accidents of this character. As far as the immediate symptoms are concerned, the results are doubtless as favorable after non-treatment as could be attained by the ordinary methods;

but, as I have suggested elsewhere, it might be possible to replace the neck to a certain degree at least by forcing the limb into extreme abduction and fixing it in that attitude by a plaster spica bandage or other appropriate apparatus. During the stage of consolidation the ordinary traction hip-splint is indicated, and I may again suggest that this appliance is useful in adult cases as well. Afterwards the patients should be kept under observation; and if the symptoms indicate that progressive

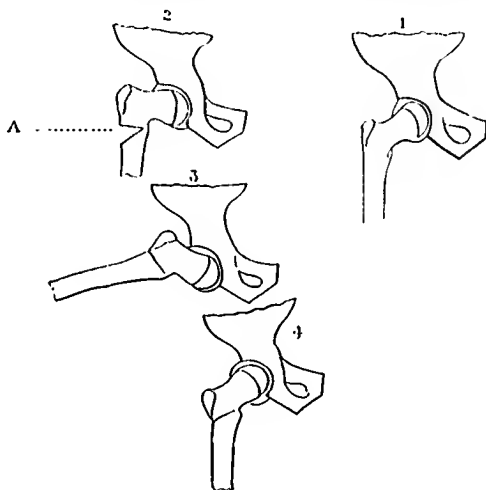


FIG. 8.—1. The normal femur. 2. Depression of the neck of the femur—coxa vara. *A*. A wedge of bone has been removed. 3. Abduction of the limb first fixes the upper segment by contact with the rim of its acetabulum, then closes the opening in the bone. 4. Replacement of the limb after union is completed elevates the neck to its former position.

deformity is probable, operative treatment, by means of cuneiform osteotomy, is advisable.

Excision of the hip has served a useful purpose in leading to the identification of coxa vara in adolescence, and in demonstrating displacement of the epiphysis, but it is hardly justifiable as a therapeutic procedure in either, at least from the stand-point of the functional result.

Of the forty-eight cases of depression of the neck of the femur, seventeen were simple primary fracture; one was undoubtedly separation of the epiphysis.

Of the remaining thirty cases, or more properly those of coxa vara, in four it seems probable that injury may have been the exciting cause of the symptoms; in two of these the deformity, as shown by Röntgen pictures, was most marked at the epiphyseal junction. In one other case an injury aggravated the symptoms of a pre-existing distortion.

In conclusion, I may state that the object of this paper, which is supplementary to other communications that I have made recently on this subject, is to place on record another case of separation of the epiphysis in adolescence, an accident that has been demonstrated by Sprengel, and to point out the essential difference between this class of cases and those of true fracture of the neck of the femur, of which anatomical evidence is now offered.

I may again call attention to the fact that depression of the neck of the femur, whether it be simple or traumatic, predisposes to progressive deformity. For this reason operative treatment may be indicated at an early stage of the affection as a preventive measure.

Finally,¹ the fact that forty-eight cases of depression of the neck of the femur have come under my observation within comparatively few years would seem to indicate that this deformity, from one cause or another, is more common than is generally believed.

(1) "Observations on Fracture of the Neck of the Femur in Childhood, with especial Reference to Treatment and Differential Diagnosis from Separation of the Epiphysis." (*Medical Record*, July 25, 1893.)

(2) "Further Observations on Fracture of the Neck of the Femur in Childhood, with especial Reference to its Diagnosis and to its More Remote Results." (*ANNALS OF SURGERY*, June, 1897.)

¹ Since this paper was written, five other cases have been seen,—two of fracture and three of simple coxa vara.

(3) "Observations on Bending of the Neck of the Femur in Adolescence, with Particular Reference to the Diagnosis and Significance of the Affection." (*New York Medical Journal*, June 23, 1894.)

(4) "Further Observations on Coxa Vara, with Particular Reference to its Etiology and Treatment." (*New York Medical Journal*, January 21, 1899.)